



**Australian Centre for Astrobiology**

**A Review: April 2002**

Malcolm Walter, Director

# *ACA Members at Macquarie University*

- Dr. Roberto Anitori - Dept of Biological Sciences
- Prof. Peter Bergquist - Dept of Biological Sciences
- Prof. Paul Davies - Dept of Earth and Planetary Sciences
- Prof. Bill Griffin - Dept of Earth and Planetary Sciences
- Dr. Roger Hiller - Dept of Biological Sciences
- Dr. Simon Jackson - Dept of Earth and Planetary Sciences
- Dr. Craig Marshall – Dept of Earth and Planetary Sciences
- Carol Oliver - Dept of Earth and Planetary Sciences
- Prof. Malcolm Walter – Dept of Earth and Planetary Sciences
- Dr. Alan Vaughan – Dept Physics



## *ACA Members at Other Institutions*

- Dr. Jeremy Bailey – Anglo Australian Observatory
- Dr. Thomas Cudahy - CSIRO Exploration and Mining
- Dr. J.M. Garcia Ruiz - Andalusian Institute for Earth Sciences, Granada, Spain
- Dr. Kath Grey - Geological Survey of Western Australia
- Dr. Arthur Hickman - Geological Survey of Western Australia
- Prof. Stephen Hyde - Australian National University
- Prof. Tony Larkum - Sydney University
- Dr. Charles Lineweaver - University of New South Wales



- Dr. Graham Logan - Geoscience Australia
- Prof. Hugh Morgan - University of Waikato
- Dr. Brett Neilan - University of NSW
- Dr. Franco Pirajno - Geological Survey of Western Australia
- Dr. David Saul - University of Auckland
- Dr. Roger Summons - MIT, Dept. of Earth, Atmospheric and Planetary Sciences
- Dr. Martin J. Van Kranendonk - Geological Survey of Western Australia
- Dr. Gregory E. Webb - Queensland University of Technology
- Dr. John Webb - University of New South Wales

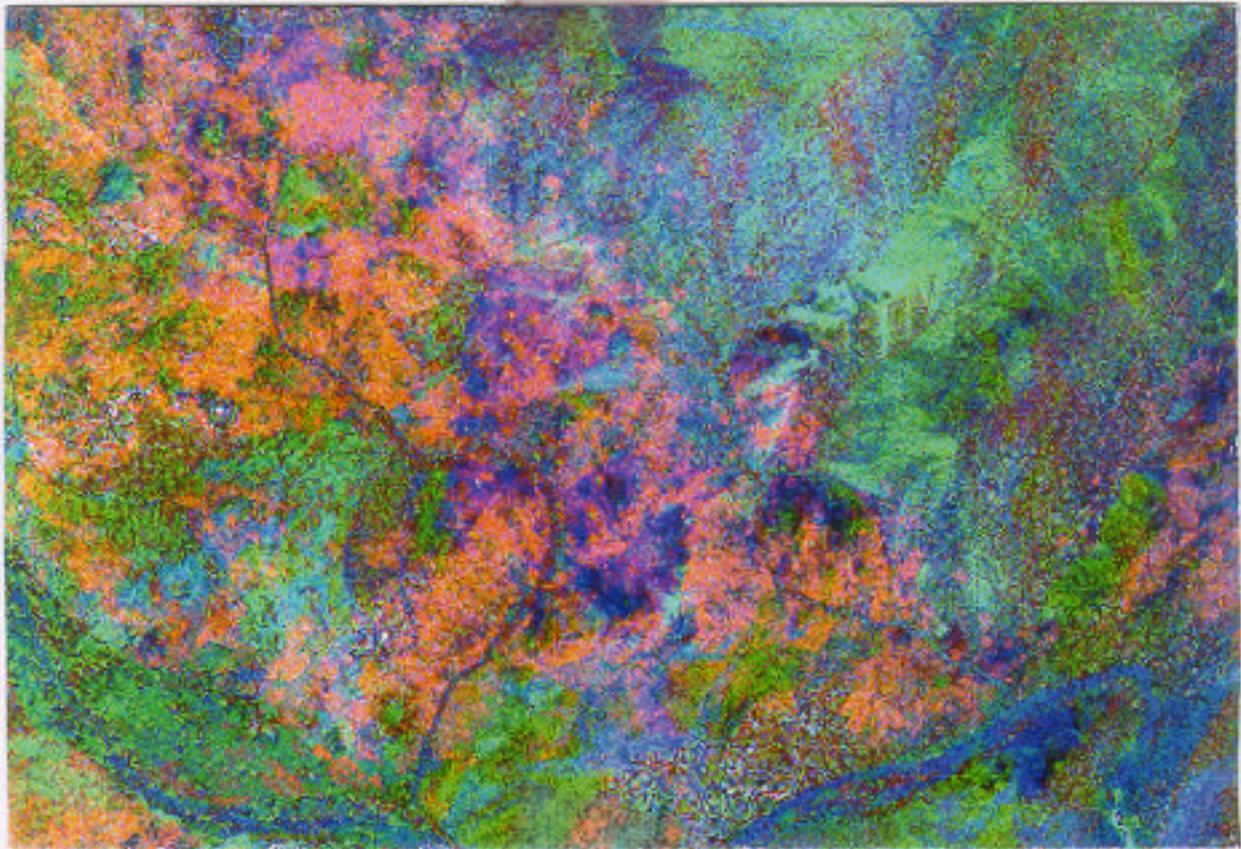


# *Mineral Mapping*

- Minerals are identified remotely by detecting their distinctive infra-red absorption spectra



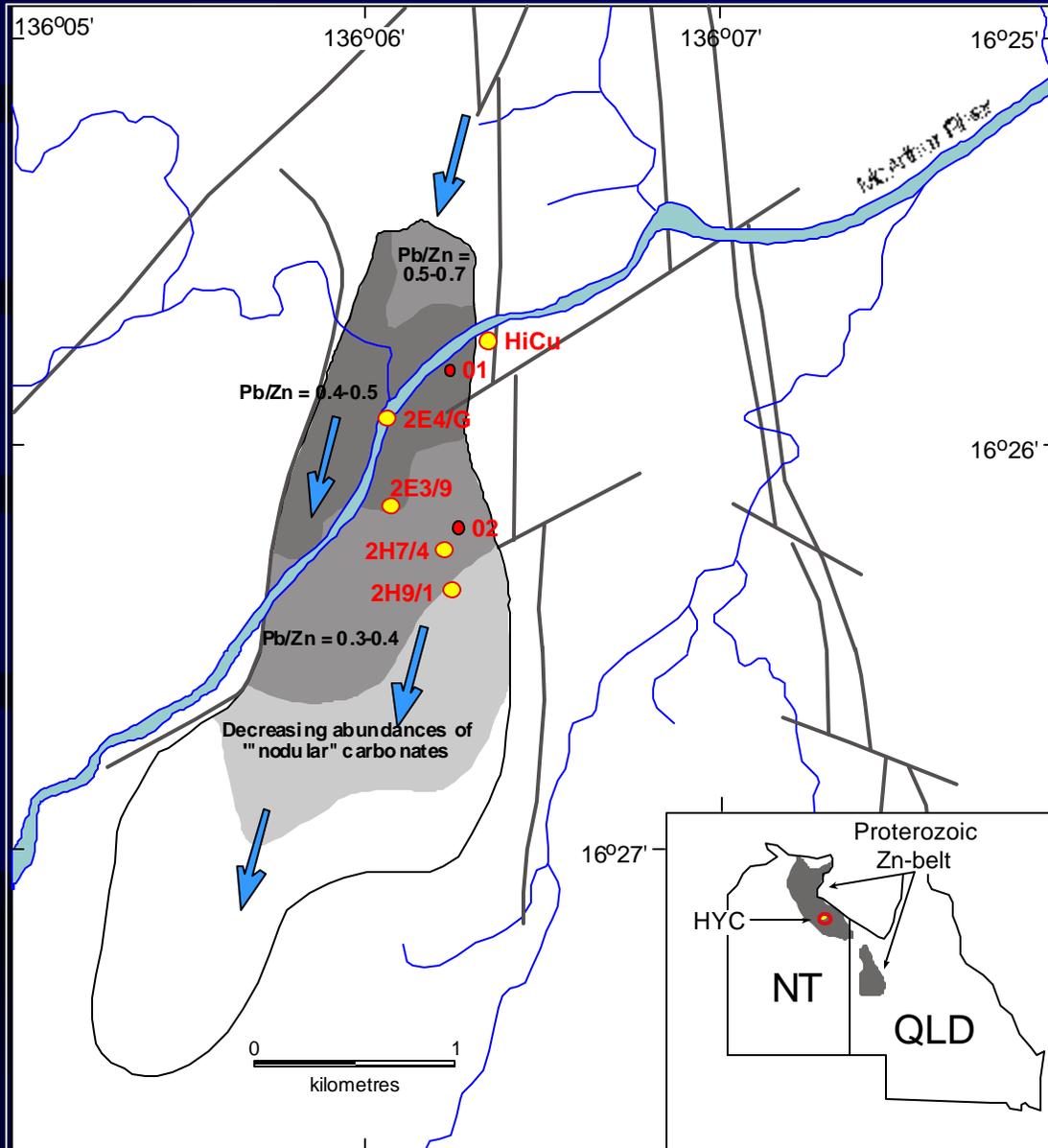
- Very large datasets are generated and complex mixed spectra representing the mixed mineralogies of rocks must be unmixed and manipulated to produce maps of mineral distributions



Mineral map of the Mt. Painter region, courtesy of Matilda Thomas

# Hydrothermal Palaeobiology

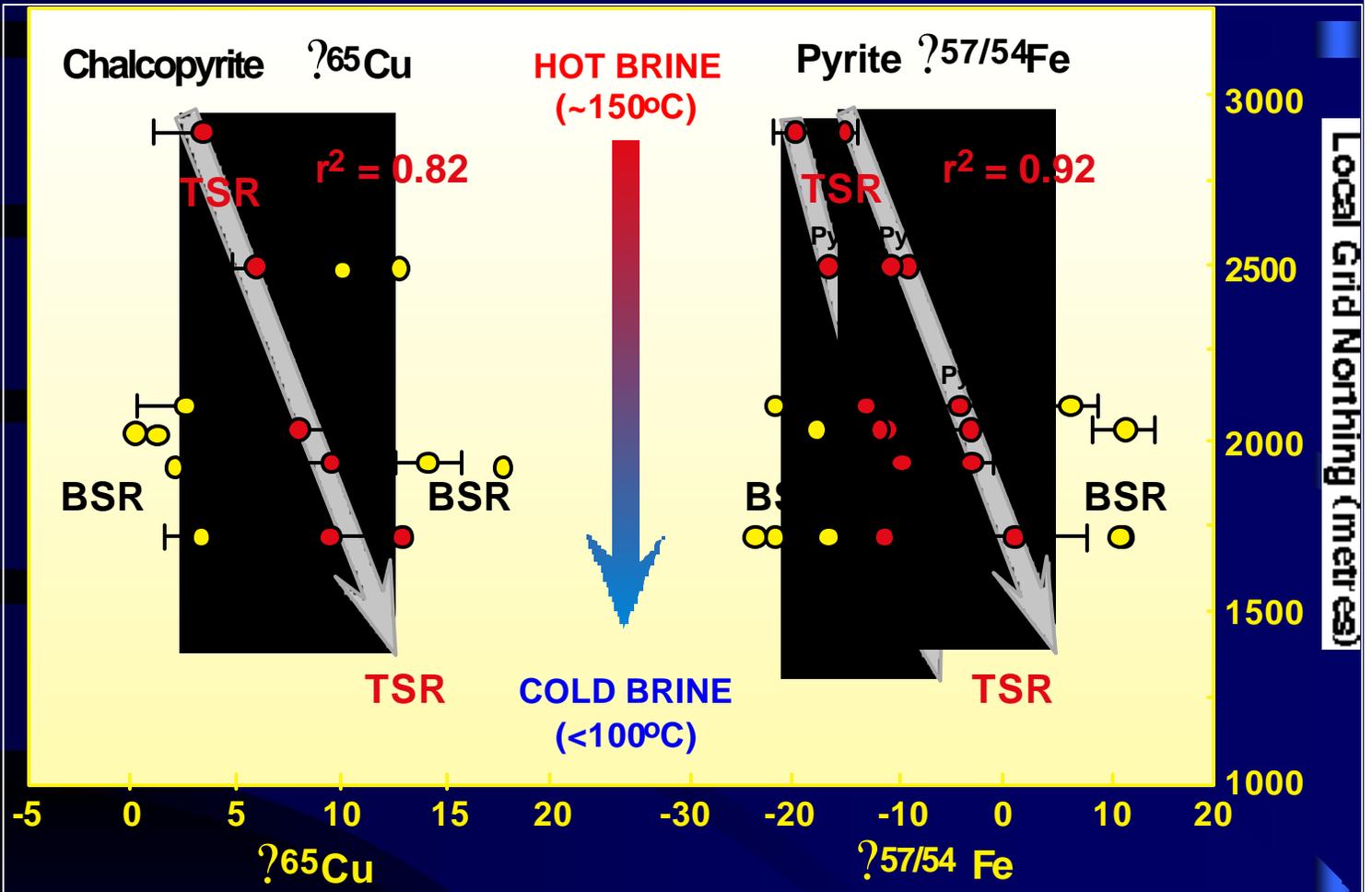
## McArthur River (HYC) Geology



Courtesy of Stuart Graham, Macquarie University



# Fe and Cu Isotopes



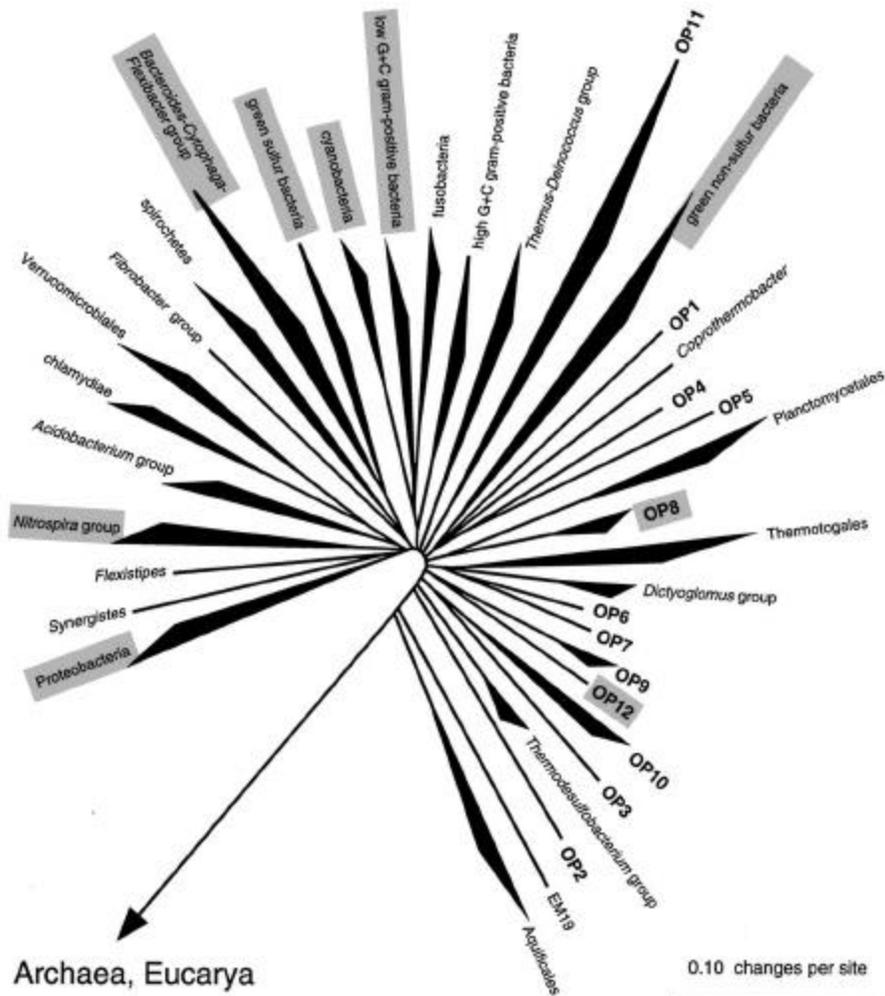
Courtesy of Stuart Graham, Macquarie University

# *Molecular Biology*



Paralanna hydrothermal spring





Courtesy of Roberto Anitori



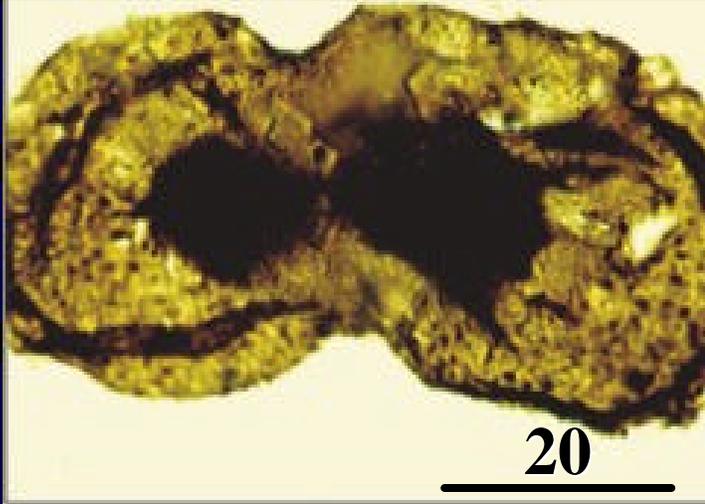
# *Effects of giant impacts – the Acraman Event*

## **Drillholes examined**

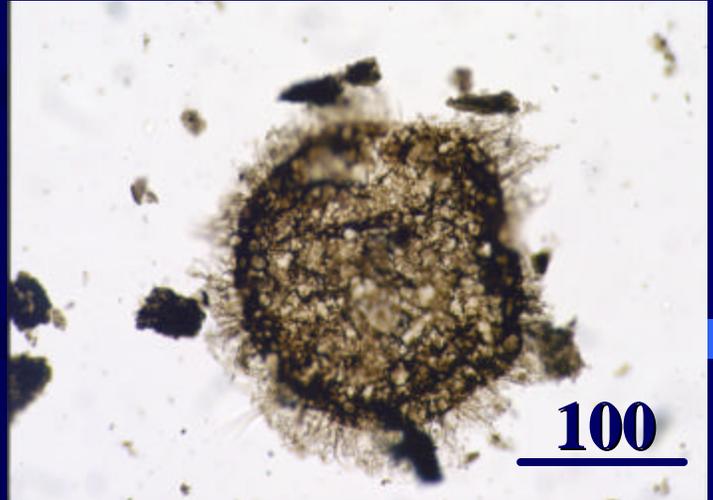


Courtesy of Kath Grey

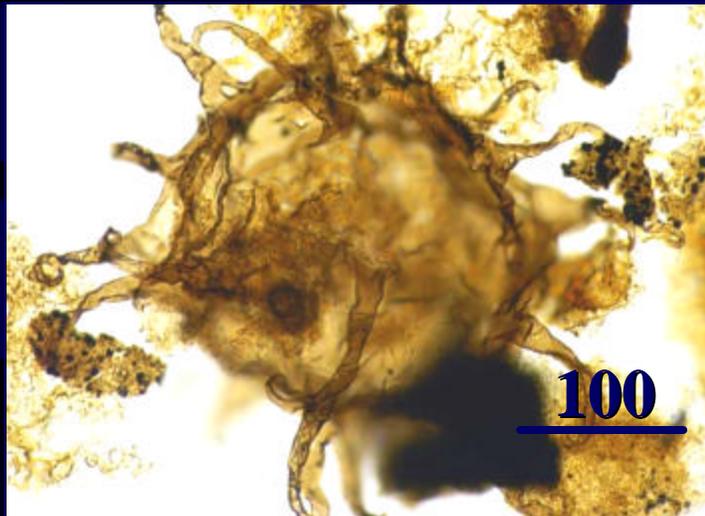




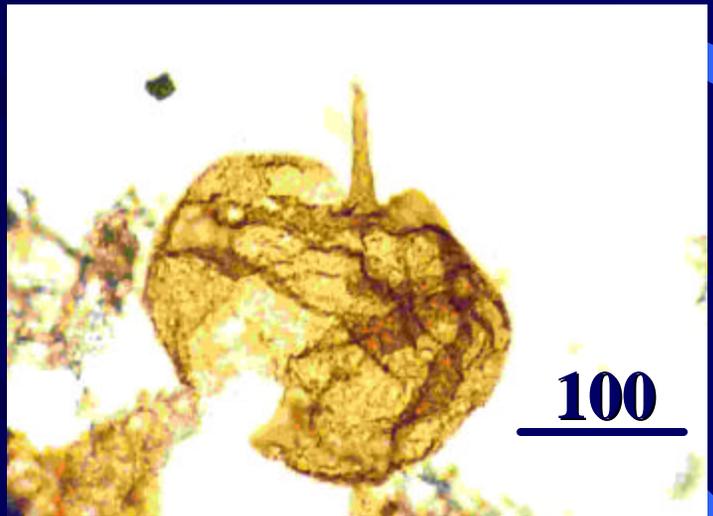
*Leiosphaeridia*



*Appendisphaera*



*Tanarium*



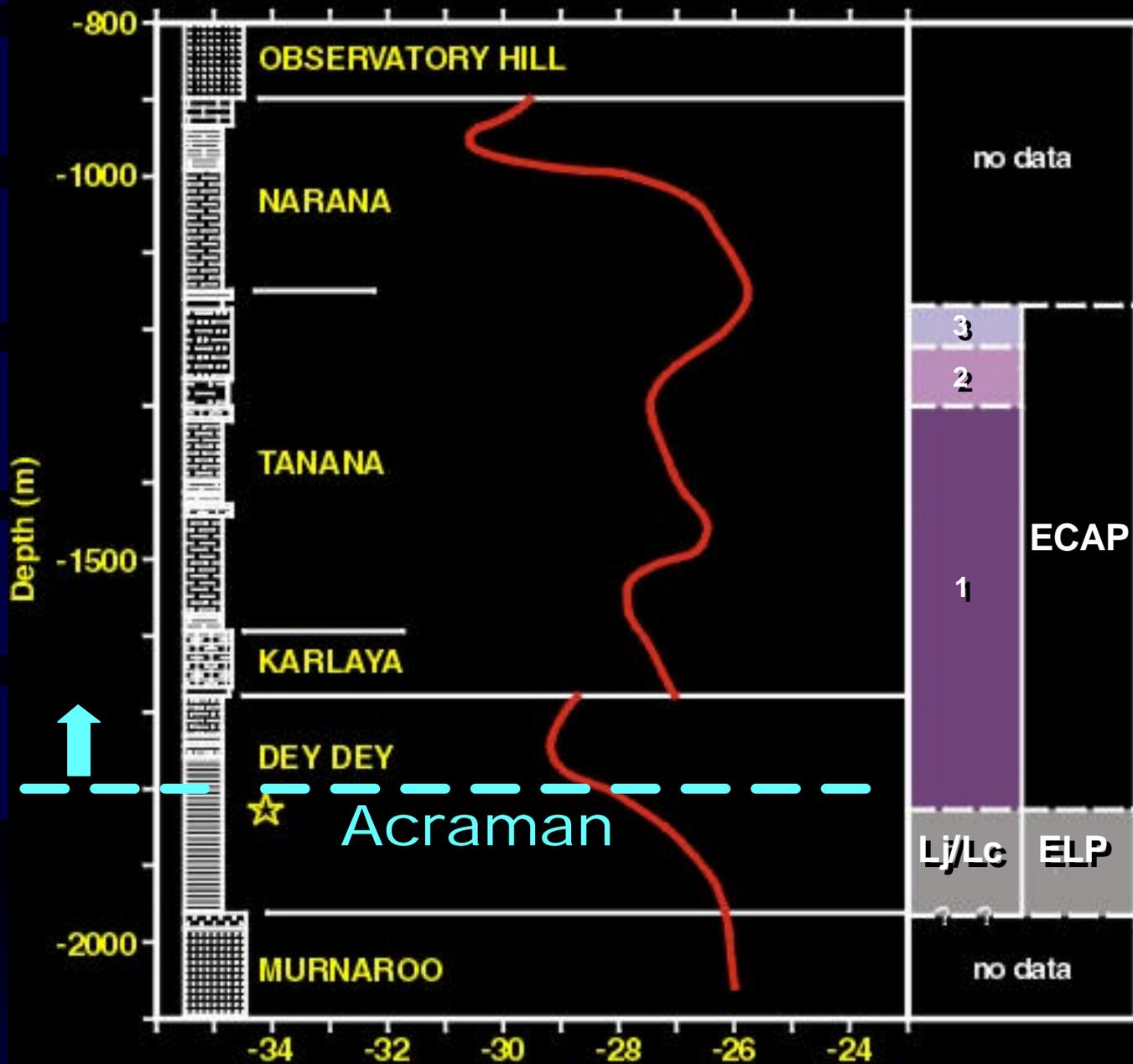
new genus

Courtesy of Kath Grey

# MUNTA 1

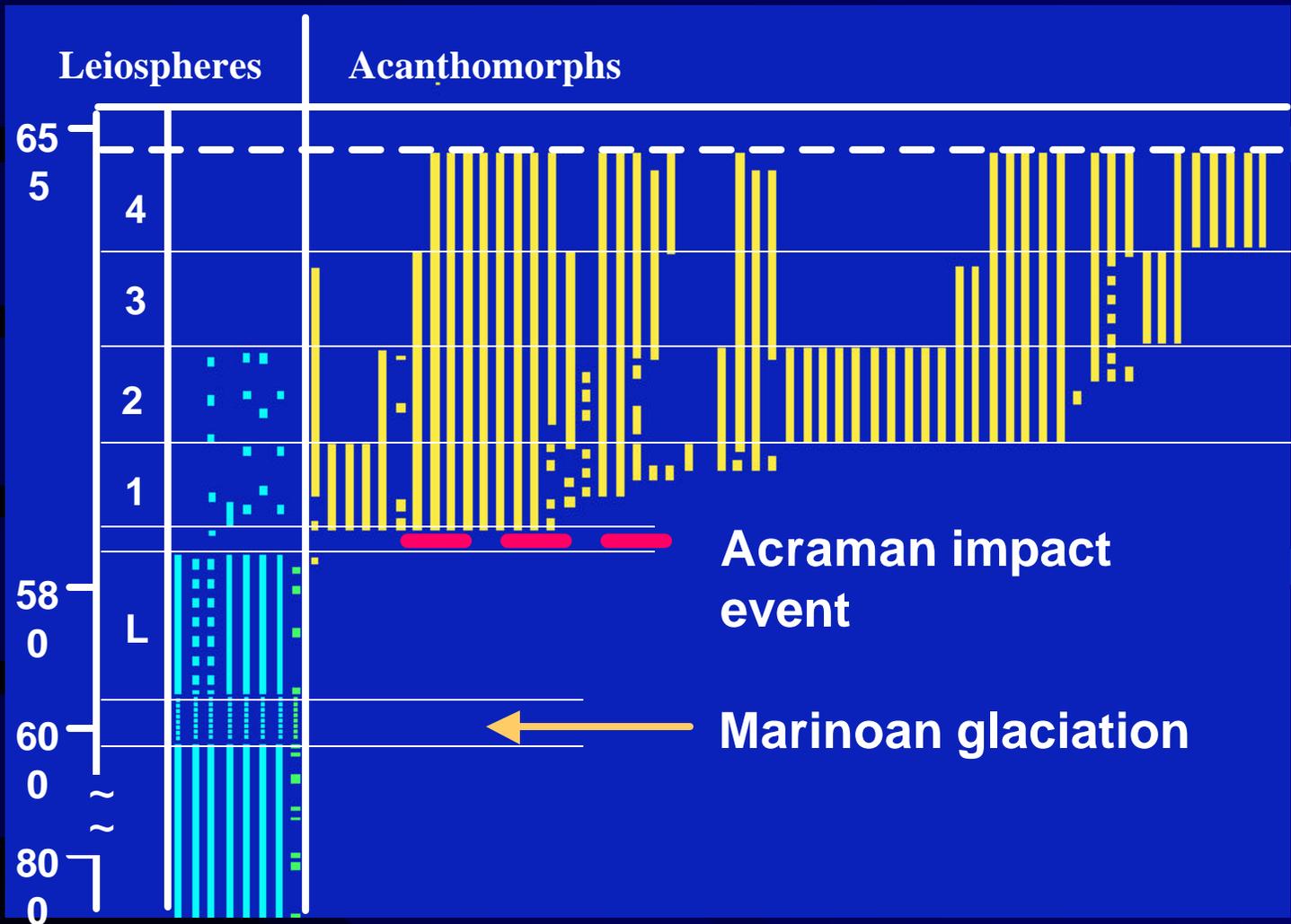
$\delta^{13}\text{C}_{\text{org}}$  Isotopes (Calver, 1995)

Palynology



Courtesy of Kath Grey





Courtesy of Kath Grey

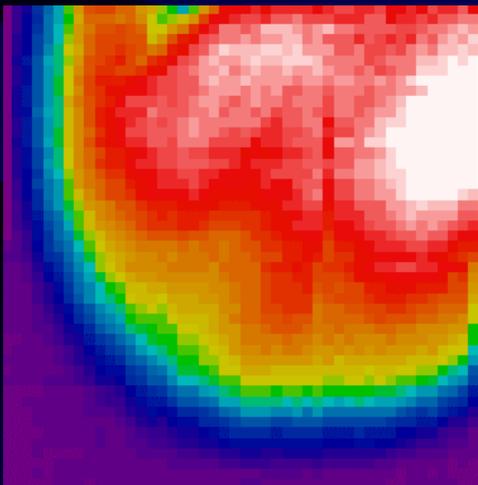
# *Quantum Information and Life*

- The idea that quantum information processing might explain life's exceptional properties remains highly conjectural
- We propose to investigate this conjecture further by applying game theory, cellular automata and other aspects of computation to the problem of the origin and evolution of life, and to determine what new features may emerge when explicitly quantum rules are imported into the study

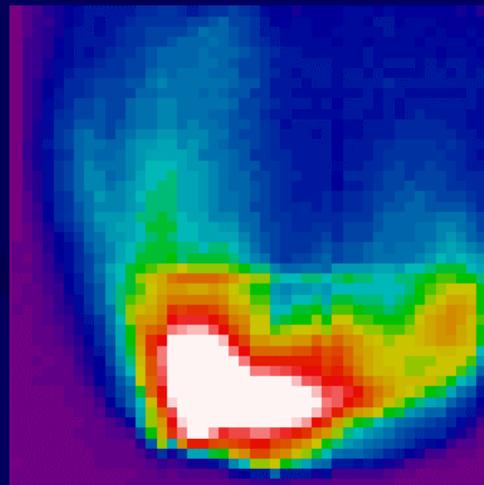


# Remote Sensing of the Atmosphere of Venus

- We study the atmosphere of Venus by using IR observations of the night side
- These see thermal emission from the surface and lower atmosphere, through the IR windows discovered by David Allen using the Anglo-Australian Telescope
- Spectral imaging observations allow us to study the structure of the  $\text{H}_2\text{SO}_4$  clouds, trace gases in the atmosphere, and the airglow emission from the upper atmosphere



1.18  $\mu\text{m}$  (lower atmosphere)



1.27  $\mu\text{m}$  (Oxygen airglow)

# *Detecting Extrasolar Planets using Polarimetry*

- This project aims to achieve the first direct detection of extrasolar planets by means of their reflected light
- We aim to detect the polarization of light scattered from the atmospheres of Hot Jupiter type planets.
  - Distinctive polarization signatures are predicted in the combined light of the star and the planet varying over the orbital period.
  - Requires polarization sensitivity of better than  $10^{-6}$
  - This is ~100 times better than current astronomical polarimeters.



- However, we believe this sensitivity can be achieved using polarimeters based on photoelastic modulators (PEMs) as demonstrated by J.C. Kemp
- We have developed a design for a polarimeter which should be able to obtain the required sensitivity, we expect to complete construction by the end of the year
- J. Bailey (ACA) + J. Hough, P. Lucas (Univ. Herts.), M. Tamura (NAO Japan)



## *Education and Outreach*

- Exhibition at the National Museum of Australia, Canberra: “To Mars and Beyond”
- Host of:
  - The International Astronomical Union’s Symposium 213: “Bioastronomy 2002: Life Among the Stars”
  - Fulbright Symposium: “Science Education in Partnership”

Both conferences to be held on Hamilton Island, Great Barrier Reef, July 8-12, 2002



## *Funding*

- Salaries, infrastructure and seed funding from Macquarie University
- New offices and laboratories 2002, \$500K
- Research grants, various sources, about \$500K/yr
- Corporate sponsorship under negotiation

